how long it fed on each food each day. Altmann established that of the 277 species of food items used by the baboons, 50 constitute the baboons' "core foods," which account for almost 95% of feeding time. Each of the core foods was analyzed for its nutritional content, which in turn formed the basis for modeling a young baboon's optimal diet. The objective in establishing optimal diets was to test what components of food alter survivorship and reproductive outcome—that is, whether the optimal diet is one that maximizes daily energy intake, maximizes daily protein intake, minimizes daily feeding time, maximizes energy intake per minute of feeding, or maximizes protein intake per minute of feeding. The basic problem of diet selection, then, is finding an appropriate mix of complementary foods.

Between the ages of 30 weeks and 70 weeks, a baboon's diet of major food categories by mass (aside from water and milk) consists of 31% flowers, seeds, and fruits; 33.9% green leaves, primarily grass; 28.5% fever tree gum; 5.4% grass or sedge meistem; and fractions of animal matter and wood, cambium, and bark. Almost 80% (by mass) of the nonmilk diet consists of acacias, grasses, and sedges. The baboons' ability to exploit these resources, Altmann notes, accounts for their success in the grass-acacia savannas of Africa.

Yearling baboons' mean intake was well below optimum by any of the five criteria (i.e., energy maximization, protein maximization, feeding time minimization, energy intake rate maximization, or protein intake rate maximization). When Altmann looked closely at individual differences, yearlings that came closer to having optimal diets were more fit later in life. Fitness for both males and females was indicated by survival to 6 years of age; for the females, fitness was indicated by reproductive life span and by the number of infants living to 1 year of age. Other primate studies—on macaques, for example—have shown that living a long time correlates with reproductive success. What is amazing about Altmann's study is the finding that female baboon yearlings whose dietary energy was closer to optimum grew up to have longer reproductive periods. Energy therefore seems to be a primary fitness-limiting component of the baboons' diet. Interestingly, although social play was highly predictable from diet, it did not predict lifetime fitness.

From time to time, Altmann notes his small sample size and half-apologizes for the limited mathematical analyses that result. What might be considered a limitation I view more as a necessary tradeoff for the fine-grained analyses of a few individuals. As someone who works on small samples myself, I nod my head affirmatively when Altmann writes, "No baboon is an average baboon" (p. 23) and "for baboons no day is an average day" (p. 171). The small vicissitudes in an individual's day to day life, mundane and trivial as those events may seem to be, provide the variation on which natural selection operates. If we are to understand the evolutionary process, we must have long-term studies focusing on individuals whose survival and reproductive outcome has been determined. Altmann has contributed significantly to that endeavor.

Beyond the wealth of data and insights into baboon adaptations, this book will be of considerable value to many researchers: to field primatologists for the methods, questions, and pointers to future research; to ecologists for the interplay of species and environment; to cognitive psychologists for issues in decision-making; to primate paleontologists for insights into fossil baboons and savanna-living hominids; and to all scientists for the perspective on life history and evolution.

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process, the implications of horizontal gene transfer are potentially profound. A 1996 conference at Fallen Leaf Lake, chaired by Michael Syvanen, was assembled with the goal of addressing the importance of horizontal gene transfer in evolution. *Horizontal Gene Transfer*, edited by Syvanen and Clarence I. Kado, is the product of that conference. The book's goal is to address three critical questions concerning the role of horizontal gene transfer in evolution: "Can genes, or more specifically DNA, move from one species to an unrelated one?" "What is the evidence that genes transfer in nature?" "Does horizontal gene transfer play any significant evolutionary role?" (pp. xxvii–xxviii). Because conferences rely on the participation of active scientists, the contributions necessarily reflect current topics, and the resulting book provides detailed, but uneven, coverage of the field. Thus, some historically important parts of the field are under-represented or neglected altogether.

Composed of 34 chapters written by roughly 90 authors, *Horizontal Gene Transfer* is clearly a group effort. With so many authors, the book's varied quality comes as no surprise. Some chapters are excellent. Others are from first-rate investigators but are brief or provide only superficial treatment of the subject. And several chapters are deeply flawed. As every unhappy family is unhappy in its own way, so each of the flawed chapters is flawed in its own way, but there is a tendency toward excessive extrapolation from minimal data, misinterpretation, or pure speculation. To be fair, the most stimulating sessions at conferences are often those that dare to be speculative, and this spirit of adventure does percolate through to the book. But *caveat emptor*; not all that glitters is gold.

The book's coverage of bacterial transformation mechanisms (chapters 2–10) is, however, quite good. To give a sense of the insights the book can provide, consider the discussion of the evolution of plasmids. Jack A. Heinemann (chapter 2) discusses the implications, for population biology, of the difference between the dynamics of the replication of individual organisms and that of mobile elements. Because an individual cell can contain many copies of a plasmid, and because plasmids can continue replicating even after a cell is not viable by normal criteria, selection on plasmids differs from selection on their host cells. In fact, some antibiotics can favor plasmids even as they kill the host. Heinemann's chapter—along with subsequent chapters in this section—reinforces the important point that replication of mobile elements does not necessarily parallel that of the organism. The book is also strong in the coverage of bacterial gene transfer in nature (chapters 11–18). The section on eukaryotic mobile elements (chapters 19–22) is more narrowly construed, but it does provide a good overview of mobile elements in insects, including P elements, *mariner*, and *hobo*. Unfortunately, this section is particularly uneven; although the discussion of insect mobile elements is excellent, the treatment of plant mobile elements is restricted to a single chapter.

The remainder of the book (chapters 23–34) is devoted to evidence for ancient transfers and to speculation on the macroevolutionary significance of horizontal gene transfer. The chapters by Syvanen (25) and by Lorraine Olendzenski, Elena Hilario, and J. Peter Gogarten (27) are well worth reading, although each serves primarily as an introduction to two complex stories (about cytochrome c in plants and chimerism in archaea, respectively), and the interested reader will have to follow references to more complete works elsewhere. Likewise, William Martin's fine chapter (28), on the phylogeny and cellular localization of Calvin cycle and glycolytic enzymes, is available in more complete form elsewhere (Martin and Schnareengerger 1997). Some of the remaining chapters—particularly in the part of the book that discusses macroevolutionary trends (chapters 31–34)—are very speculative. Several of these chapters are interesting, however, and one could charitably say that scientific investigation begins with speculation and that page limitations may have made it difficult to fully develop some of the complex issues involved.

As a whole, then, the book does a good job of answering its first two questions—it shows that genes can indeed be transferred among distantly related organisms and provides substantial information concerning some of the mechanisms by which this transfer occurs. The third question—whether horizontal gene transfer plays an important evolutionary role—is less completely answered. Certainly, there can be little doubt that most, if not all, genomes include a number of foreign genes (i.e., from outside of the main genomic lineage), but the qualitative effect of these genes remains unclear.

At times, it seems that horizontal gene transfer creates something completely new. In ancient mythology, the chimera was a beast composed of bits and pieces of lion, goat, serpent, and perhaps other creatures tossed haphazardly. By contrast, the griffin was a more orderly combination, with the head and wings of an eagle and the body of a lion. It is tempting to think that every gene transfer gives us a griffin—an organism that is neither eagle nor lion but a wholesale combination of the two—rather than a chimera. If the griffin model holds, one would expect to find suites of genes, with congruent phylogenies within the suite but discordant phylogenies among suites. By contrast, with his "you are what you eat" hypothesis, W. Ford Doolittle (1998) has suggested a mechanism—at least for some organisms—by which one would expect the gradual introduction of foreign genes a few at a time. Because a foreign gene would rarely be replaced by one from within the lineage, he predicts a ratchett effect that would lead to the eventual replacement of much of the genome, but with DNA from varied sources. Under this model, the bulk of the genes in the genome would share a common ancestry, while several distinct origins would be discernable for
Taking in the Sites

In the words of geneticist Theodosius Dobzhansky, "Nothing in biology makes sense except in the light of evolution." Unfortunately, however, what is clear in the laboratory often becomes muddled in the public eye, especially when the theory is seen as having implications for religion. The following Web sites provide a wealth of resources, opinions, and scientific findings on the topic of evolution.

Mainstream scientific perspectives on the creationism/evolution controversy can be found at www.talkorigins.org/origins/faqs-evolution.html, the archives of Talk.Origins. Visitors can read several essays, including "Evolution is a Fact and a Theory" and "What is Darwinism?" The full text of On the Origin of Species can also be accessed from this site. After reading Darwin's seminal text, visitors may be inclined to celebrate Darwin Day with the Darwin Coalition from the University of Tennessee-Knoxville. Although the actual event is held on campus during spring semester 2000, an online discussion forum on education and on evidence for evolution can be accessed from their Web site (tp.bio.utk.edu/darwin/frmain.html).

In the past few months, the topic of teaching evolution in schools has become a matter of national debate. As part of its goal to be a clearinghouse of information about keeping evolution in the classroom, the National Center for Science Education (www.natcenscied.org) has developed a resource-filled Web site that includes synopses of court rulings on the issue of evolutionary education and a FAQ section that provides educators and students with information on how to deal with controversy in the classroom. The Human Evolution Education Network, an NCSE-sponsored project bringing together K–12 teachers and scientists, can also be accessed. Educators and students may also want to check out "Evolution on the Web for Biology Students" (www.iup.edu/~rgendron/bi112-a.htmlx), compiled by a biology professor at the Indiana University of Pennsylvania. Using an outline format, the author explains the history of evolutionary thought and the science of evolution.

To help catalog the tremendous amount of information on evolution on the Web, the Biology and Evolution Jump Station (meiosis.8m.com) lists links to a wide range of sources, including publications of prominent biologists, sites on evolution and genetics, and sites on creationism. The Science and Engineering Library at the State University of New York at Buffalo (ublib.buffalo.edu/libraries/units/ev/bio/evolweb2.html) has also compiled an extensive annotated list of links to evolution and evolutionary biology Web sites. This resource makes it easy to find information on topics such as natural selection and genetic drift, the fossil record, human evolution, and the origins of life. Evolution doesn't have to be all seriousness though—be sure to check out the links to "fun stuff," including the annual "Darwin Awards" and evolution games.

Other sites of interest include:

Internet Infidels: www.infidels.org/library/creationism
Teaching About Evolution and the Nature of Science: www.nap.edu/readingroom/books/evolution98

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the introduced genes. The result would be less a griffin than a true chimera, revealing a concordant whole with a variety of parts grafted on. Even when substantial parts of the genome have been replaced, the griffin model should be discernable from that of the chimera.

Horizontal gene transfer may be as common as it seems to be precisely because most transfers that become fixed in the population are selectively neutral. In this context, horizontal gene transfer may simply be another mechanism producing genetic variation, and no more likely to produce a hopeful monster than any other form of mutation. Does Horizontal Gene Transfer resolve all such issues? No, but it does provide ample food for thought.

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NEW TITLES


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